Double-acting vacuum pump

Patent number: GB2040361
Publication date: 1980-08-28
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Applicant: PIERBURG GMBH & CO KG
Classification:
- international: F04B49/00; F04B25/00
- european: F04B37/14; F04B39/00B4
Application number: GB19790043601 19791218
Priority number(s): DE19782855608 19781222

Also published as:
JP55123384 (A)
GB2040361 (A)
FR2445903 (A1)
DE2855608 (A1)
SE7910423 (L)
more >>

Abstract of **GB2040361**

This invention relates to a double- action vacuum pump with a piston 2, separating two working chambers 3,4, each equipped with an inlet valve 7,8 and an outlet valve 5,6 and in which the inlet valves communicate with a vacuum tank 11. According to the invention the two working chambers are arranged to act in parallel until the pressure in the tank has decreased to a certain critical low value, after which they act in series. Preferably to this end the piston incorporates at least one spring-loaded non-return transfer valve 14. Alternatively, the piston may incorporate two spring-loaded non-return transfer valves working in opposite flow-directions.

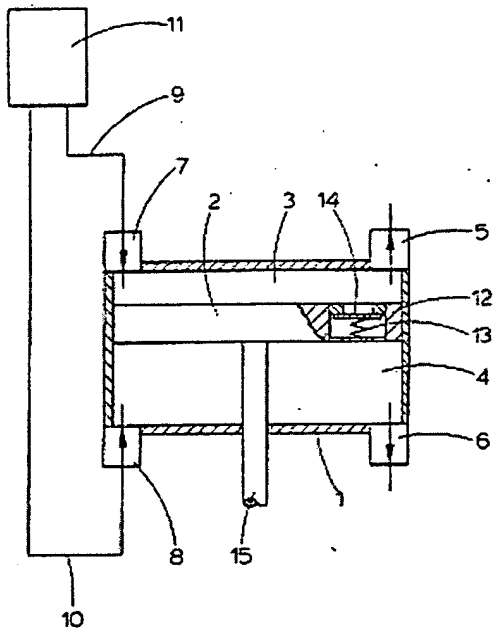

Fig.1

(12) UK Patent Application (19) GB (11) 2 040 361 A

(21) Application No 7943601
(22) Date of filing 18 Dec 1979
(30) Priority data
(31) 2855608
(32) 22 Dec 1978
(33) Fed.Rep of Germany (DE)
(43) Application published
28 Aug 1980
(51) INT CL³
F04B 49/00 25/00
(52) Domestic classification
F1N 1E1A 2D2E 2G1A4
(56) Documents cited
None
(58) Field of search
F1N
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(54) Double-acting vacuum pump

(57) This invention relates to a double-action vacuum pump with a piston 2, separating two working chambers 3,4, each equipped with an inlet valve 7,8 and an outlet valve 5,6 and in which the inlet valves communicate with a vacuum tank 11. According to the invention the two working chambers are arranged to act in parallel until the pressure in the tank has decreased to a certain critical low value, after which they act in series. Preferably to this end the piston incorporates at least one spring-loaded non-return transfer valve 14. Alternatively, the piston may incorporate two spring-loaded non-return transfer valves working in opposite flow-directions.

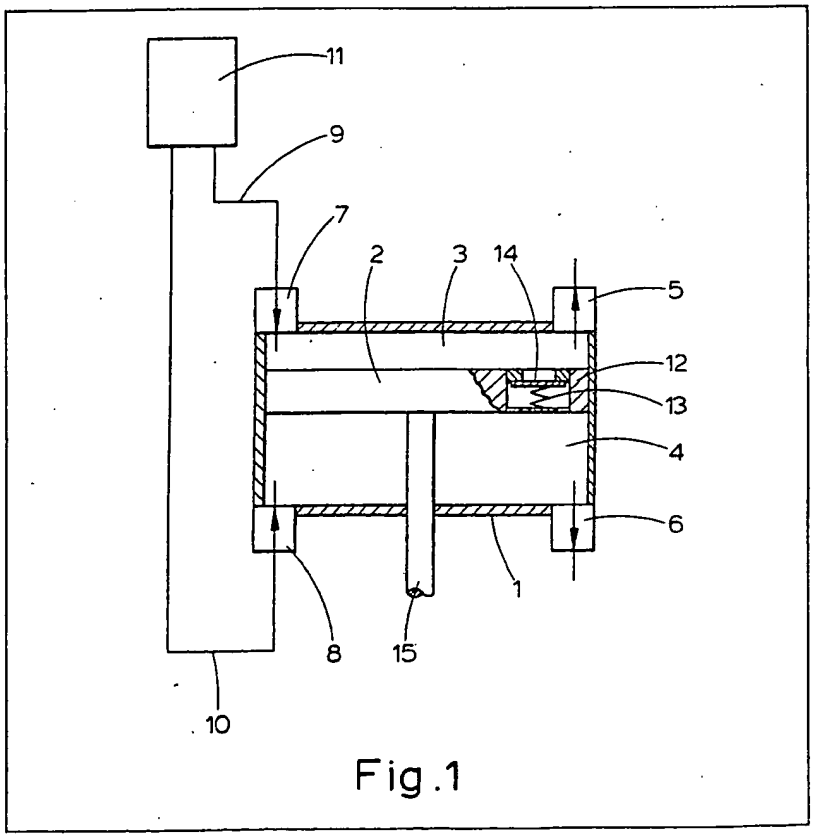

Fig.1

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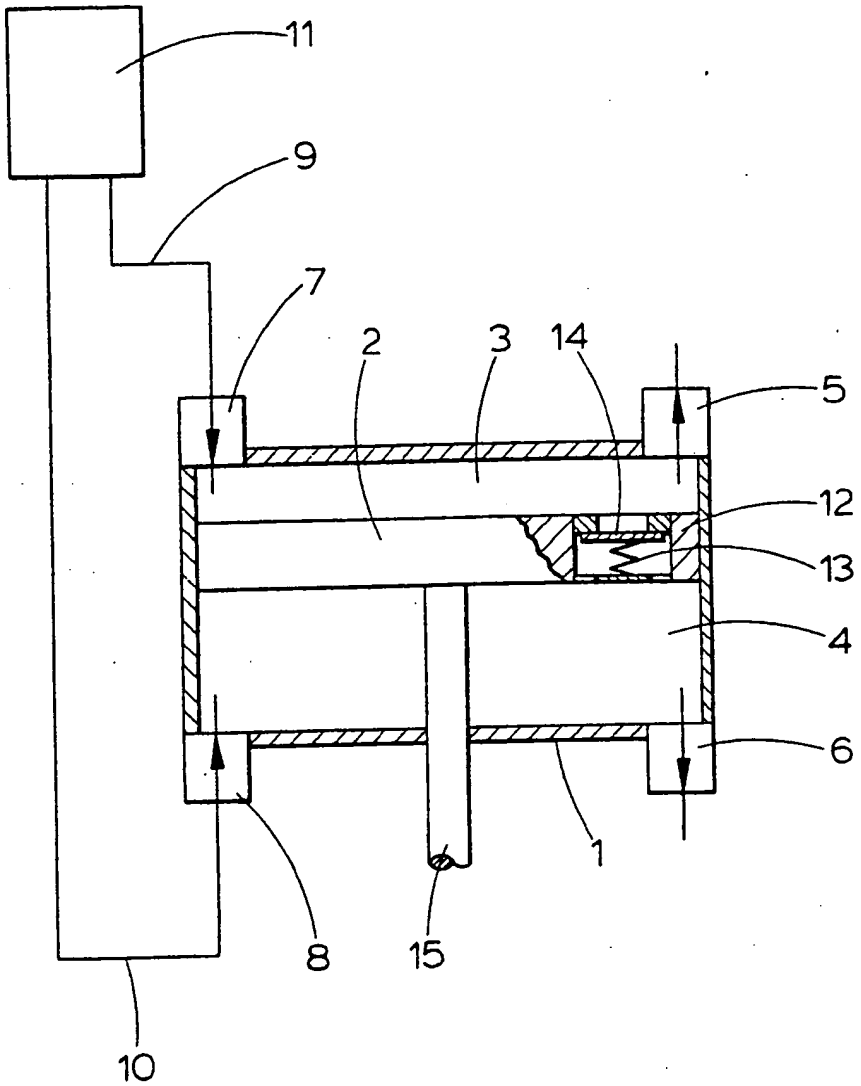

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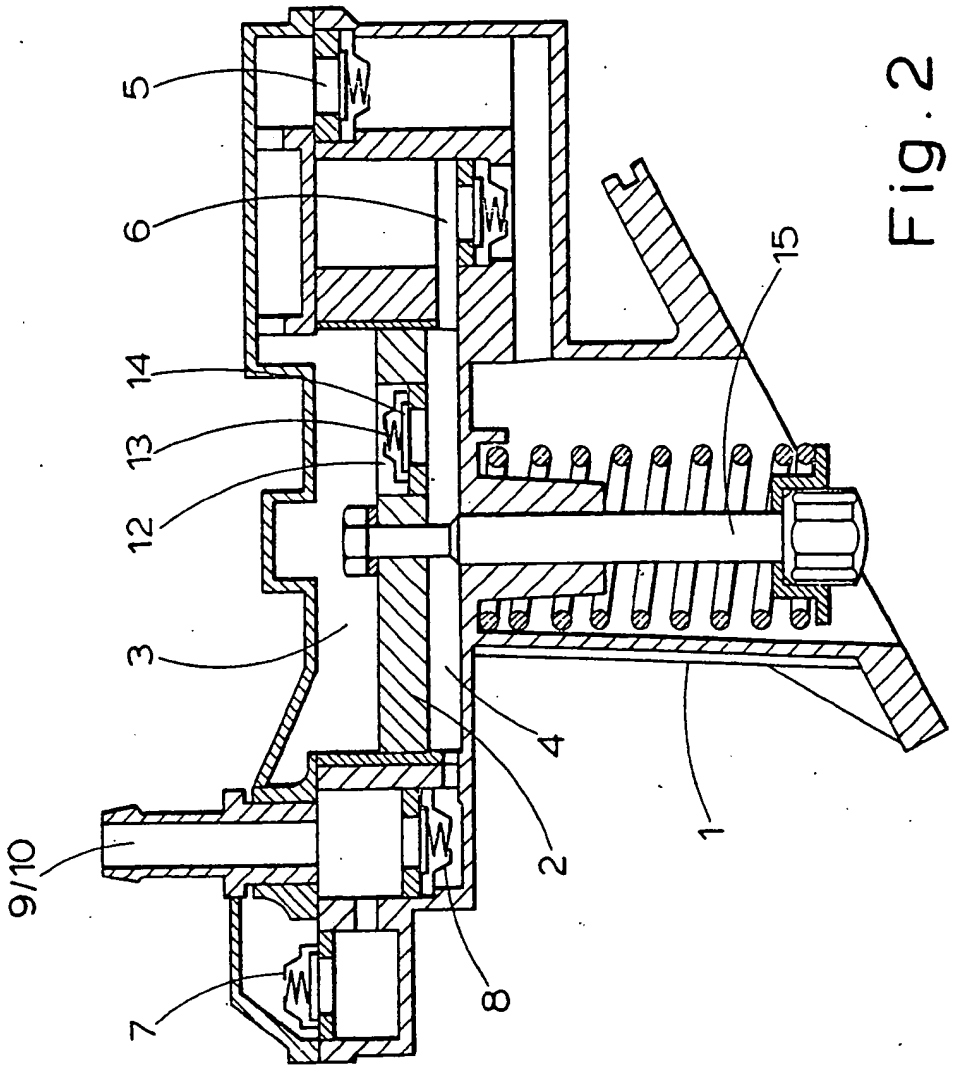

Fig. 2

SPECIFICATION

Double-action vacuum pump

The invention relates to a double-action vacuum pump with a piston, or the like, separating two working chambers, each equipped with an inlet valve and an outlet valve, the inlet valves communicating with a vacuum tank.

Motor vehicles are often equipped with several servo devices, for example for powered steering and for the brakes, which operate by suction from a vacuum tank. Two important requirements have to be satisfied. In the first place, when the vehicle has been standing for a long time, for example in a garage, the suction in the vacuum tank can have deteriorated greatly. When the engine is subsequently started up, the pump must evacuate the vacuum tank very rapidly, within a few seconds, for supplying adequate suction to the servo devices. The second requirement is that when the vehicle is under way, the pressure in the vacuum tank must be constantly kept low enough to ensure that even a continuously sustained operation of a servo device, in particular the brakes when the vehicle is running down a long hill, cannot reduce the supply of suction to a dangerously low level. In other words, the pump must build up suction rapidly during starting up, and must produce and maintain a high degree of suction (atmospheric pressure less tank pressure) when the vehicle is running on the road.

The intention in the present invention is to provide a vacuum pump which, without excessive consumption of power, builds up adequate suction rapidly in the vacuum tank, for starting up, and which produces and maintains a high degree of suction in the vacuum tank when the vehicle is running on the road.

The problem is solved in the present invention in that, starting out from a pump of the kind described at the beginning, the two working chambers are arranged to act in parallel until the pressure in the vacuum tank has decreased to a certain critical low value, after which they act in series.

Although one could, in principle, obtain the desired result by mounting a system of change-over valves on the outside of the pump, it is simpler and more practical to instal, for this purpose, a spring-loaded non-return valve in the piston itself. If desired there can be two such valves in the piston, working in opposite flow-directions.

An example of the invention is represented diagrammatically in the drawing, in which:

Figure 1 is a diagram to illustrate the principle involved; and

Figure 2 shows a practical example of the pump.

The vacuum pump 1 which will now be described has a piston 2, but if desired a flexible diaphragm can be used instead.

The piston 2 separates an upper chamber 3, equipped with an inlet valve 7 and an outlet valve 5, from a lower chamber 4 equipped with an inlet valve 8 and an outlet valve 6. The two inlet valves 7 and 8 communicate in common through lines 9 and 10 only to the suction-consuming devices of the vehicle, such as a powered steering gear, brakes and the like.

Built into the piston 2 is at least one spring-loaded non-return transfer valve 12, whose spring 13 acts on a valve plate 14. The valve 12 opens to allow air to pass downwards from the upper chamber 3 into the lower chamber 4. If desired there can be a second spring-loaded non-return valve, which opens to allow air to pass upwards from the lower chamber 4 into the upper chamber 3.

The method of functioning of the pump will now be described. Let it be assumed, to begin with, that the vehicle has been left standing for so long that the vacuum tank 11 contains atmospheric pressure. When the engine is started up, the piston 2 is driven in reciprocation by a piston rod 15. When the piston 2 is moving upwards it sucks air from the vacuum tank 11, through the inlet valve 8, into the lower chamber 4, the outlet valve 6 remaining closed. Above the piston 2, air is being expelled from chamber 3 through the outlet valve 5, the inlet valve 7 being closed. On the other hand, when the piston 2 is moving downwards, air is sucked from the vacuum tank 11 into the chamber 3, and air is expelled from chamber 4 through the outlet valve 6 into the surrounding atmosphere.

During this phase of operation the transfer valve 12 remains closed all the time because the vacuum tank 11 still contains air under a substantial pressure and consequently the pressure difference between the two chambers is not sufficient to open the transfer valve 12. It will be obsrved that under these circumstances the two chambers act in parallel and independently of each other, each evacuating the tank directly.

But once the pressure in the vacuum tank has decreased to a certain critical low value, which will be termed the "critical tank pressure", the pump begins to function in a different manner. The critical tank pressure is determined by the thrust of spring 13. During upward movement of the piston 2, when the piston approaches top dead centre, the pressure difference between the two chambers becomes enough to open the transfer valve 12, against the influence of its spring 13 so that air flows downwards from chamber 3 into chamber 4. In other words, chamber 3 is now being exhausted into chamber 4, the exhaust valve 5, on which full atmospheric pressure acts externally, remaining closed. When the piston reaches top dead centre the residual pressure in the chamber 3 is therefore less than atmospheric pressure. In fact it is almost as low as the pressure in chamber 4. During the subsequent downwards movement of the piston the vacuum tank 11 is evacuated, by chamber 3, to a still lower pressure. When the piston now reaches bottom dead centre, chamber 4 contains atmospheric pressure. But during the subsequent upwards movement of the piston the inlet valve 8 does not open until the pressure in chamber 4 has fallen to the very low pressure now existing in the tank, that is the good vacuum created by chamber 3 is not degraded by passage of air through inlet valve 8 but is maintained constantly by the action of chamber 3. Under these

Chamber 3 pumps the air into chamber 4, which subsequently expels it through its outlet valve 6. The pressure in the tank is reduced to a very low value and maintained there constantly.

The pump therefore functions through two successive phases. As long as the pressure in the tank is above the critical tank pressure the two chambers act in parallel, for rapid evacuation of the tank. Below the critical tank pressure the two chambers act in series, evacuating the tank to a very low pressure and maintaining this constantly.

CLAIMS

1. A double-action vacuum pump with a piston, or the like, separating two working chambers, each equipped with an inlet valve and an outlet valve, the inlet valves communicating with a vacuum tank, characterised in that the two working chambers are arranged to act in parallel until the pressure in the tank has decreased to a certan critical low value, after which they act in series.

2. A vacuum pump as claimed in claim 1, characterised in that the piston, or the like, contains at least one spring-loaded non-return transfer valve.

3. A vacuum pump as claimed in claim 1, characterised in that the piston, or the like, contains two spring-loaded non-return transfer valves working in opposite flow-directions.

4. A vacuum pump substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by Croydon Printing Company Limited, Croydon Surrey, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.